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A Study of the Predaceous Insect Enemies Of the Western Forest Scolytids

Preliminary Report

Introduction

This investigation is being carried on as a part of the S.Ore.-N.Calif. Pine Beetle Control Project. The two species of scolytids against which the work is being done are the Western Pine Bark Beetle (Dendroctonus brevicomis) which is by far the most important and the Northern Pine Beetle (Dendroctonus monticolae). Yellow Pine (Pinus ponderosa) is the principal host tree being treated, with a small amount of Sugar Pine (Pinus limbertiana).

Altho the present methods of control, namely the felling and barking of the infested trees, and the burning of the bark has proven practical and is saving many millions of feet of lumber, it is still far from satisfactory. It is very costly and is working against natural laws, always a dangerous procedure. Our friends, the enemies of the destructive scolytids are being destroyed as fast as are the bark beetles; and after an area has been "controlled," the proportion of natural enemies to scolytids is probably as unfavorable as during the epidemic stage of the infestation.

For these reasons it is hoped that it will be possible, by learning more about our beneficial insects, to at least modify our present control methods so as to work with, rather than against natural laws.

In connection with the control of the Western Pine Beetle and the study of its habits hundreds of square feet of Yellow Pine bark containing the broods of this Bark Beetle was caged and all emergence collected. A large amount of similar bark was carefully shaved up and the contents examined. From these studies the fact that the predators were much more important than the parasites soon became apparent. For this reason it was thought advisable to start an investigation of the natural means of control with a study of the predators.

Predaceous Enemies of the Western Pine Beetle.

The following list of predators, in probable order of importance, was made up from the field notes at the Northfork, Calif. Forest Insect Station, checked and supplemented by the personal observation and feeding experiments conducted by the writer. Some species are included which are merely suspected of being predatory. Further study will be necessary before we can be sure of their habits.

Temnochila virescens var. chlorodia - Coleoptera - Ostomidae (Trogositidae)-Fisher Id. Larvae and adults are both voracious feeders on all stages of D. brevicomis and monticolae, with the possible exception of the egg stage.

Thanasimus nigriventris - Coleoptera - Cleridae-Van Dyke Id. Ranks very close to T. virescens chlorodia in importance as a predator of D. brevicomis. Are predaceous in both adult and larval stages.

Enoclerus sphegeus - Coleoptera - Cleridae - Fisher Id. A very important enemy especially of D. ponderosae and D. monticolae in both larval and adult stage. Also reported from D. brevicomis infested yellow pine.

Cucujus clavipes var. puniceus-Coleoptera-Cleridae-Fisher Id. Reported as predaceous on D.brevicomis. Adults in cages feed readily on D.b. adults.

Tenebroides sp. Coleoptera Fisher Id. Adults found beneath bark of yellow pine in Ips. spp. and D. brevicomis galleries. Predaceous on D.b. adults in cage. Of minor importance.

Aulonium longum Coleoptera - Colydiidae - Fisher Id. Larvae and adults have been observed feeding on D.brevicomis pupae and adults respectively by H. E. Burke and by Sergent and Wagner. The writer conducted a number of feeding experiments but was unable to get them to feed on any of the stages of D. brevicomis or D. monticolae.

Deretaphrus oregonensis Coleoptera ? Fisher Id. Adults found beneath bark of D.brevicomis infested yellow pine. Adults in vials with D.b. adults were found to be predaceous to a slight extent.

Othnius umbrosus Coleoptera Cleridae Fisher Id. Adults reared from D.b. infested yellow pine bark. Habits unknown but as most of the clerids are predaceous this species probably is also.

Larvae often abundant beneath bark of D.b. infested yellow pine.

Hypophloeus parallelus Coleoptera Tenebrionidae Fisher Id.

Platysoma pumctiger " Histeridae "

Spp. " Staphylinidae

The above insects are common beneath the bark of pines infested with D.brevicomis and D.monticolae. Some of them have been considered predaceous but the writer believes that they are in general feeders on decaying matter and fungi. It is possible that some of them may feed on the eggs of scolytids but as they are usually found after the brood is well developed even this is very improbable.

Rhaphidia oblita? Neuroptera Rhaphididae

This species has been reported as predaceous on D.brevicomis broods in its larval stage. The writer has been unable to get it to feed on any of the stages of D.b. or D.m. It is of only minor importance if a factor at all.

Notes on the More Important Predators

Temnochila virescens var. chlorodia.

The writer considers this species the most effective of any of the predators. Each individual destroys practically as many adult scolytids as any of the clerids, its nearest competitors, and the larvae are much more beneficial than the clerid larvae. This fact soon became evident from the feeding experiments conducted by the writer. The T.v.c. larvae are much larger and feed readily on scolytid larvae, pupae and adults, while the clerid larvae are unable to attack, successfully, scolytid adults and feed with difficulty on the larger scolytid larvae and pupae. The abundance of T.v.c. and T. nigriventris is about the same. From careful counts of all larvae of both species from 71 sq. ft of bark made at Northfork, Calif, it was found that numerically they were equal.with 62 of each larvae.

Life History and Habits As the life history has not been worked out as yet, only certain facts in regard to it can be given at this time. The over-wintering stages are the adults in bark crevices in the outer bark and large to small larvae in the bark. Judging from rearings at room temperature during the winter, the larger over-wintering larvae would emerge as adults beginning about ~~just~~ June 1st in the Klamath Falls region and varying with the weather conditions. These would probably mate and lay eggs during June which should become adults during August and in turn lay eggs which would develop into the larvae which would over-winter. The smaller larvae would be later in de-

veloping so that the summer brood would not reach the adult state until late in September and many of these would remain as the over-wintering adults. The developement of the over-wintering adults would probably correspond with the development of broods from over-wintering D.brevicomis adults. The larvae live in the bark in D.brevicomis infested trees and between wood and bark in D.monticolae trees. They pupate ~~with~~ in the bark in unlined cells.

Feeding habits. Larval. The larvae bore at will thru the bark in search of the D.brevicomis broods, feeding readily on the larvae, pupae and new adults. In controlled feeding experiments it was found that one medium large larva would consume a dendroctonus adult in two days. About the same as the T.v.c. adult. Feeding experiments with D.brevicomis larvae were unsuccessful as it was not possible to tell whether all of the larvae were intentionally killed by the predaceous larvae or accidently lacerated due to close quarters. Actual feeding of a T.v.c. larva on a D.brevicomis larva was observed in two instances, however. During the feeding the larvae of both prey and predator were confined in a small glass vial well filled with frass, to simulate conditions in the bark. The dendroctonus larva was cut open in the abdominal region by the jaws of its predators and the internals eaten. Little of the hypodermis was eaten. It was also found that the larvae are cannibalistic as they will feed on each other if no other food is available. Unfortunately they will also attack clerid larvae if dendroctonus larvae are not to be found.

Feeding habits of adult. The adults are usually found lying motionless in the outer bark crevices. In attacking, the ostomid seizes the adult dendroctonus with its jaws, at any convenient point, and crushes the exoskeleton. The soft internals are then consumed and often the exoskeleton as well, leaving only the wings, elytra, legs and more heavily chitinized head parts. The victim is held entirely with the jaws which are able to crush any part of the exoskeleton. The dendroctonus is usually forced into a crevice in the bark so that it can be more easily held during the feeding process.

In a controlled feeding experiment covering a period of about a month and in which 7 Temnochila v. chlorodia adults and a large number of D.brevicomis adults were used; it was found that the "day-beetle" consumption of this predator was .5. That is, each predator destroyed one dendroctonus every two days.

During the feeding experiments the beetles were confined in one or two-quart fruit jars containing small slabs of bark and bark shavings in the bottom. As these conditions were not normal this probably does not give the correct consumption for these predators in the field. However, as the feeding conditions for all of the predators tested were similar, these experiments indicate the conparative effectiveness of the different species.

Thanasimus nigriventris

This species has been confused with Enoclerus sphegeus in a number of instances, especially in the larval stage, at which time they are difficult to distinguish. Both of these clerids are well known as predators and have always been considered the most effective predators of the western scolytids. As E.sphegeus is quite rare in the Klamath Falls region I have had no opportunity to study its habits and so will confine myself to T.nigriventris in this report.

Life history and habits. Our knowledge of the life history of this species is as limited as is our knowledge of the life history of T.v. chlorodia. From the large quantity of winter brood bark examined a large number of T.nigriventris larvae from very small to prepupal were found. As no adults were found the larval stage is probably the principle over-wintering form. It seems reasonable to suppose, from their habits, that these larvae develope with the D.brevicomis over-wintering larvae. All stages of this predator are found thruout the summer and up into October. Pupae were found as early as March 15 at Northfork, Calif. As a number of larvae were reared thru to adults at room temperature some facts can be given.

A larva found in D.brevicomis infested bark 12-29-22 changed to a pupa 1-27-23 and to an adult 2-2-23.

A larva found in prepupal call, 1-12-23, changed to a pupa, 1-23-23 and to an adult 2-4-23.

The prepupal larvae form a flattened cell in the bark which they line with a white silky substance. The adults emerge and begin to feed at once if food is available.

Copulation was observed a number of times in the glass jars in which the adults were confined. The male mounted the female so as to bring its (the males) head to the caudal end of the females pronotum; the abdomen of the female being clasped by the two anterior pairs of legs of the male. The process lasted about 30 seconds.

Oviposition was not observed but a number of eggs were found (3-11-23) on slabs of yellow pine bark kept in the cage - a two quart fruit jar. The eggs are still under observation, none having hatched as yet (3-24-23). The eggs were layed on the surface of the bark with little effort at concealment. Only twelve eggs were found from four females. This number is probably far below the normal amount as conditions were not very favorable.

Description of egg. Color, pink with a white curcular band near the smaller end; length, .05 - .07 In., diameter at largest point, .014 - .018 in.; shape, subsylindrical with a slightly curved axis and a taper toward each end but more pronounced toward one end than the other; no surface markings.

Feeding habits, larval. The T.nigriventris larvae bore thru the bark in search of their prey, in much the same manner as the Temnochila virescens chlorodia larvae do. They are evidently unable to feed on the dendroctonus adults, however. All that could be determined from the feeding experiments was that

the clerids killed a smaller number of dendroctonus larvae than T.v.c. and also that they would not feed on adults.

Feeding habits, adult. As the adults like the sunlight and feed always in the open it is easy to observe their method of attack on D.brevicomis adults. The clerid moves about very rapidly over the bark and when it encounters a D.b. it seizes the victim with its four anterior legs, balancing itself on its two posterior legs and the tip of its abdomen. Regardless of the position of the scolytid when seized the clerid always turned it so that their ventrums were opposed and their heads in the same direction. The point of attack was usually either at the juncture of the head and thorac or at the juncture of the thorac and abdomen. The amount of the D.b. actually consumed varied from a small amount of soft internals to practically all of the body except the wings, elytraand the more heavily chitinized parts of the exoskeleton. Usually only the internals are eaten.

The clerids were also found to feed on adult rhaphidids when the supply of scolytids was exhausted.

From feeding experiments conducted similar to those with T.v.c. it was found that the "day-beetle" consumption of this clerid was .66, a little higher than for T.v.c. The writer believes this difference to be due to the fact that the clerid adults used were newly emerged adults while the T.v.c. were old over-wintering adults which would have less vitality.

Cucujus clavipes var. puniceus

All that is known concerning this species is that it is occassionaly found beneath the bark of D.b. infested yellow pine and that it is predaceous, at least in the adult stage.

In a feeding experiment two adults ate 22 D.b. adults in 18 days. A "day-beetle" consumption of .58. As this figure is higher than that for T.v.c. the cucujids are evidently effective predators. As they are much less common than either of the preceding species they are of less importance. Then, too, the larvae are seldom found with D.b. broods, thus lessening still more their importance. They will be studied further, by the writer, as opportunity is offered.

Summary.

There is still a great deal to be done before this study will be of much value. However, the following conclusions will pave the way for more intelligent work, along this line, in the future.

1. The ostomid, Temnochila virescens var. chlorodia is the most effective of the predators of D.brevicomis, being more effective than Thanasimus nigriventris, its nearest competitor. These two species are of about equal value in the adult stage and are practically equal numerically.

The T.v.c. larvae, however, are capable of destroying a much larger number of scolytids since they are evidently longer lived, are much larger in size and are able to feed on scolytid

adults as well as on larvae and pupae. The T.n. larvae are unable to feed on scolytid adults.

2. Cucujus clavipes var. puniceus is a predator of some value in the adult stage since it is often found on D.b. infested trees and has been found to feed readily on D.b. adults.

The colydiid, Aulonium longum, is evidently of little value as a predator. Among the many records of this insect only two reports give actual cases where it has been found feeding on a scolytid. These records are reliable but the writer believes that they are exceptional cases and that this beetle is not generally predaceous. Reasons for this belief are that there are so few of the above cases while the beetle itself is so abundant; and that the writer has been unable to get either the A.l. adults or larvae to feed on any of the stages of D.brevicomis, monticolae, or valens in feeding experiments. These experiments were carefully conducted over a period of a month and a half under the same conditions in which the ostomids, clerids and cucujids were found to feed readily.

Further study should be directed toward working out the following:

1. Details of the life histories of the important predators. This knowledge may enable us to modify present artificial methods of control so as to work with these predators rather than to destroy them with the scolytids, as is now done.

2. Data from the field showing percentages of the broods destroyed by each of the predators and in different stages

of an infestation; normal, on the increase and on the decline.

3. Possibilities of quantity rearing and transportation to areas where an infestation is on the increase.